University of British Columbia
CPSC 111, Intro to Computation
Jan-Apr 2006

Tamara Munzner

Class Design II

Lecture 7, Thu Jan 26 2006

based on slides by Paul Carter

http://www.cs.ubc.ca/~tmm/courses/cpsc111-06-spr

Reading This Week

- Chap 3
- Reading for next week
  - re-read Chapter 4.1-4.6

News

- Assignment 1 due Tue Jan 31 5pm
- Extra TA hours in ICICS 008 to answer questions
  - Thu Jan 24 (today!) 4-6pm
    - Olivia Siu
  - Fri Jan 25 5-7pm
    - Ciaran Llachlan Leavitt
  - Sat Jan 26 12:30-2:30pm
    - Simon Hastings
- Weekly questions due today
  - Stay tuned for bboard postings with (some) answers
- Midterm reminder: Tue Feb 7, 18:30 - 20:00
  - Geography 100 & 200

Recap: Escape Characters

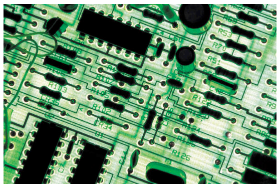
- How can we make a String that has quotes?
  - `String foo = “oh so cool”;`
  - `String bar = “oh so \”cool\”, more so”;`
- Escape character: backslash
  - general principle

Recap: Random Numbers

- **`Random`** class in **`java.util`** package
  - **`public Random()`**
    - Constructor
  - **`public float nextFloat()`**
    - Returns random number between 0.0 (inclusive) and 1.0 (exclusive)
  - **`public int nextInt()`**
    - Returns random integer ranging over all possible int values
  - **`public int nextInt( int num )`**
    - Returns random integer in range 0 to (num-1)

Recap: Abstraction

- Abstraction: process whereby we
  - hide non-essential details
  - provide a view that is relevant
- Often want different layers of abstraction depending on what is relevant



Recap: Encapsulation and Info Hiding

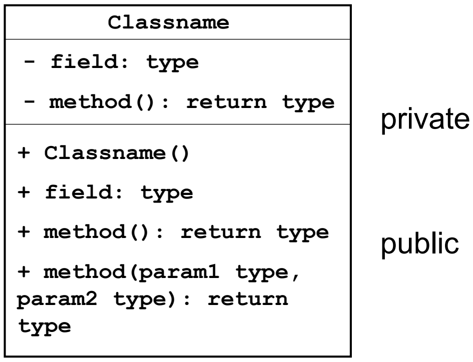
- Encapsulation: process whereby
  - inner workings made inaccessible to protect them and maintain their integrity
  - operations can be performed by user only through well-defined interface.
  - aka information hiding
- Hide fields from client programmer
  - maintain their integrity
  - allow us flexibility to change them without affecting code written by client programmer
    - Parnas' Law:
      - "Only what is hidden can by changed without risk."

Recap: Designing Classes

- Blueprint for constructing objects
  - build one blueprint
  - manufacture many instances from it
- Consider two viewpoints
  - client programmer: want to use object in program
    - what public methods do you need
  - designer: creator of class
    - what private fields do you need to store data
    - what other private methods do you need

Recap: UML

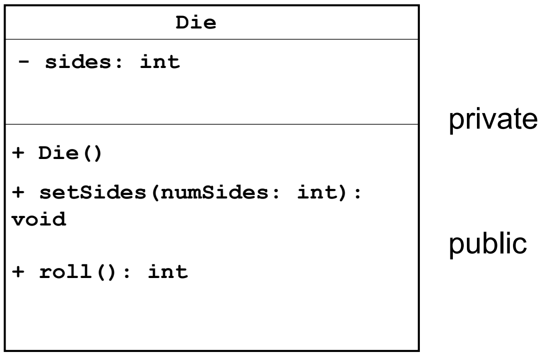
- UML diagram representing class design



```
Classname
- field: type
- method(): return type
+ Classname()
+ field: type
+ method(): return type
+ method(param1 type,
param2 type): return
type
```

Recap: UML

- UML diagram for **Die** class we designed



```
Die
- sides: int
+ Die()
+ setSides(numSides: int):
void
+ roll(): int
```

Objectives

- understand how to design new classes using abstraction and encapsulation
- understand how to implement new classes in Java

Implementing Die

- Last time
  - designed UML diagram
  - first draft of implementation
    - it compiled, but untested!
- This time
  - refine implementation
  - test and debug implementation

Using **Die**

- Change hats from **Die** designer to **Die** user
- Roll two dice
  - print each value, and sum
- Design and implement **RollDice** driver: class with main method

Implementing **RollDice**

```
public class RollDice
{
   public static void main ( String [] args)
   {







}
```

Separation and Modularity

- Design possibilities
  - **Die** and **RollDie** as separate classes
  - one single class that does it all
- Separation allows code re-use through modularity
  - another software design principle
- One module for modeling a die: **Die** class
- Other modules can use die or dice
  - we wrote one, the **RollDice** class
- Modularization also occurs at file level
  - modules stored in different files
  - also makes re-use easier

Control Flow Between Modules

- So far, easy to understand control flow: order in which statements are executed
  - march down line by line through file
- Now consider control flow between modules

Client code

```
int rollResult;
myDie.setSides();
rollResult = myDie.roll();
```

Die class methods

```
public int roll()
{
   …
}

public void setSides()
{
   …
}
```

Designing **Point**: UML

- class to represent points in 2D space

Implementing **Point**

```
public class Point {








}
```

Formal vs. Actual Parameters

- formal parameter: in declaration of class
- actual parameter: passed in when method is called
  - variable names may or may not match
- if parameter is primitive type
  - call by value: value of actual parameter copied into formal parameter when method is called
  - changes made to formal parameter inside method body will not be reflected in actual parameter value outside of method
- if parameter is object: covered later

Scope

- Fields of class are have class scope: accessible to any class member
  - in `Die` and `Point` class implementation, fields accessed by all class methods
- Parameters of method and any variables declared within body of method have local scope: accessible only to that method
  - not to any other part of your code
- In general, scope of a variable is block of code within which it is declared
  - block of code is defined by braces { }

Key Topic Summary

Borrowed phrasing from Steve Wolfman

- Generalizing from something concrete
  - fancy name: abstraction
- Hiding the ugly guts from the outside
  - fancy name: encapsulation
- Not letting one part ruin the other part
  - fancy name: modularity
- Breaking down a problem
  - fancy name: functional decomposition